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PHYSICAL CHEMISTRY.—*The influence of pressure on the solubility of sodium chloride in water. A new method for the measurement of the solubilities of electrolytes under pressure.*[1] L. H. ADAMS and R. E. HALL, Geophysical Laboratory, Carnegie Institution of Washington.

In this paper is described a method for the determination of the solubility of a salt or other electrolyte under pressure. The method involves (1) a means for measuring the concentration of a solution in a place inaccessible to direct observation, as in a pressure apparatus, without disturbing the equilibrium between solid and liquid, and (2) a simple arrangement for obtaining saturation in a vessel that can not be shaken and is not provided with a mechanical stirrer. The concentration is determined by measuring with sufficient precision the electrical resistance of the solution, and saturation is attained by using a cell in which convection-currents readily produce complete equilibrium between solid and liquid. This method has been applied to the study of the system, $NaCl$-H_2O, under pressure, and some measurements on the effect of pressure on the solubility of sodium chloride have been made.

Apparatus. The conductivity cell, shown in Fig. 1, was constructed of Kavalier glass with platinum electrodes sealed through the sides of the narrow part of the cell, which was about 5 mm. inside diameter and about 4 cm. between electrodes. In order to obtain with saturated salt solutions a resistance that was not inconveniently low, especially in a cell small enough to go into the pressure apparatus, small ring-shaped electrodes were used. These were made by bending platinum wire of 0.4 mm. diameter into circular loops about 3 mm. outside diameter and then closing the loop by soldering with gold. The electrodes were

[1] Received March 25, 1931.

coated with platinum black in accordance with the usual procedure[2] for conductivity measurements. Outside the cell the platinum wires were fused on to gold wires in order to have the resistance of the leads as low as possible. Near the top and at the bottom of the cell, as shown in the diagram, were placed several crystals of the salt under investigation, the remainder of the space inside the cell, up to within 1.5 cm. of the top, being filled with saturated solution. The enlarged portion at the lower end of the cell was fitted with a ground joint to facilitate the placing of crystals at the bottom. It was expected that convection currents in the cell would operate in such a way as to keep the solution always saturated. Thus, if at any time the concentration were less than the equilibrium value, solid would tend to dissolve, and the more concentrated, denser, solution would sink toward the bottom of the cell. This action would continue until the solution became completely saturated. On the other hand, if for any reason the solution became supersaturated, salt would crystallize out, and the less concentrated, lighter, solution produced at the bottom of the cell would rise toward the top, until as before equilibrium was attained. Furthermore, it was expected that the attainment of equilibrium in a cell of the size and shape shown in the diagram would be sufficiently rapid to make the method a convenient one. How well this supposition was justified will be evident from some preliminary experiments, which will be described below.

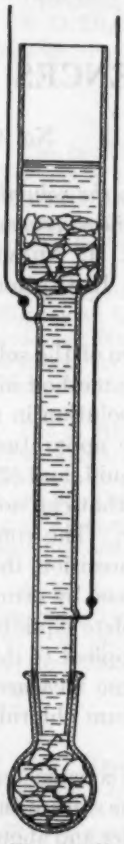

Fig. 1.—Conductivity cell for obtaining saturated solution under pressure, (about natural size).

In order to use the electrical conductivity for determining the solubility of an electrolyte[3] at various pressures it is necessary to know the conductivity over a range of concentrations in the vicinity of saturation and also over the range of pressures at which it is

[2] KOHLRAUSCH and HOLBORN. Das Leitvermögen der Elektrolyte, p. 9 (Leipzig, 1898).

[3] The application of conductivity to the analysis of solutions has been discussed in detail by KOHLRAUSCH and HOLBORN (*op. cit.*). Conductivity methods have been used to determine the progress of chemical reactions at atmospheric pressure by WALKER and KAY (J. Chem. Soc. 71: 489. 1889) and by WALKER (Proc. Roy. Soc. 78 A: 157. 1908), and at higher pressures by COHEN and KAISER (Zeit. phys. Chem. 89: 338. 1915).

desired to work. Some measurements have already been made by previous investigators on the effect of pressure on the conductivity of solutions of various salts including sodium chloride, but the pressure-range was not large enough, and sufficient attention was not given to the nearly saturated solutions. Even at atmospheric pressure, although the conductivity of dilute solutions has been thoroughly investigated, the available data for concentrated solutions are so meager that they are practically valueless for measuring concentrations.

Additional measurements were therefore required. The detailed results of the investigation on the conductivity of sodium chloride solutions under pressures up to 4000 bars (metric atmospheres) and the complete description of the apparatus will be published in another paper. The conductivity-cell, surrounded by sulphur-free oil, was subjected to pressure in a steel bomb, which was placed in a thermostat, with kerosene as the liquid. The temperature was maintained at 30°, because of the inconvenience of running the thermostat at a lower temperature during the summer months. The maximum variation in temperature of the thermostat was 1 or 2 thousandths of a degree. Pressure was generated by means of a hand-pump and pressure-intensifier, and was measured with a resistance-gauge. The cell was connected to insulated leads at the top of the bomb and thence to a slide-wire bridge, which was supplied with alternating current at 1000 cycles per second. A telephone receiver served to determine the balance-point of the bridge. On account of the tendency to heating-effects in the type of cell that was used, the maximum current that could safely be passed through the cell was about 0.5 milliampere. When the limiting current is so small, sufficient sensitivity can not be obtained with the telephone alone; but by connecting a two-stage electron-tube amplifier between the bridge and the telephone[4] there is no difficulty in making the bridge-setting to within one-tenth of a division, which corresponds to a precision of 1 part in 50,000 in the resistance-measurement. This precision is quite satisfactory for electrolytic solutions, although, of course, much greater refinement is possible in the measurement of metallic resistances, with which direct current can be used.

Test of saturation in the convection-cell. Prior to the determination of solubility under pressure, a preliminary experiment was made to find out how well saturation would take place in the chosen type of cell. For this purpose it was sufficient to alter the conditions so that the solubility of a particular salt would be increased or decreased and to

[4] HALL and ADAMS. Journ. Am. Chem. Soc. 41: 1515–1525. 1919.

observe the course of the conductivity with time. The simplest way to alter the solubility is by changing the temperature, and for convenience a salt with a large temperature-coefficient of solubility should be chosen. Accordingly the saturation-test was conducted as follows: The cell was nearly filled with saturated $CuSO_4$ solution, crystals of the salt being at the top and bottom, as shown in Fig. 1. It was then placed in the bomb just as it was for the measurements under pressure, and the thermostat adjusted to a temperature around 30°. After equilibrium was attained, as shown by the resistance of the cell reaching a constant value, the temperature was changed somewhat (usually one-half to one degree) and the resistance of the cell again measured at suitable intervals of time. This procedure was repeated at several temperatures so that equilibrium would be approached from both above and below and at two different temperatures. The first and large effect observed after each change of temperature was that due to the temperature-coefficient of resistance, but since the temperature had probably become quite uniform as well as constant in one-half hour or less, the subsequent drift in resistance was due to the change in concentration of the solution. Apparently this change takes place approximately according to a simple exponential relation with respect to time, so that saturation, following a rise in temperature, proceeds about half way to equilibrium in 2 hours, and is sensibly complete in 24 hours. On the other hand, after a drop in temperature about 5 hours is required for the change in concentration to reach one-half the final amount, and about 2 days to be completed. This difference in behavior in the two cases is probably connected with the way in which equilibrium is attained within the convection-cell. When the solution is unsaturated, as for example immediately after a rise in temperature, the solution proceeds to saturate itself by dissolving salt at the top, but, when it is supersaturated, salt crystallizes out at the lower end. Probably the rate at which salt will dissolve at the top is considerably greater than that at which it will crystallize at the bottom.

In Table I are summarized the results of the preliminary test of the convection-cell. The first column gives the equilibrium temperature; the second, the change in temperature immediately preceding the maintenance of constant temperature; and the third, the final value for the resistance. Each of the 8 series of measurements was continued for 2 to 8 days in order to make sure that the resistance had become constant. The average of the 4 equilibrium values at 30.05° is 247.700 ohms, and of the 4 at 30.95° is 242.240. From the fourth column of

Table I, which shows the deviation in resistance from the corresponding average, it is evident that equilibrium was attained to a very satisfactory extent. The average deviation (without regard to sign) is 0.010 ohm, and the uncertainty in the equilibrium value is therefore only about twice the uncertainty in the resistance measurements themselves.

It is important to determine what this degree of precision means in terms of the concentration of salt in the solution. From conductivity data[5] it may be calculated that at 30° with a saturated solution of $CuSO_4$ (19.6 per cent) a decrease in salt content of 1 per cent—i.e., from 19.6 to 18.6 per cent—will cause a fractional increase in resistivity of 0.023, which with a cell of 240 ohms resistance gives 5.5 ohms change for 1 per cent change in concentration. From this it follows that an uncertainty of 0.010 ohm in resistance corresponds to 0.002

TABLE I.—SUMMARY OF RESULTS OF SATURATION TEST

Temperature (°C.)	Previous temperature change	Resistance at equil. (ohms)	Deviation of resist. from av.
30.05	−0.90	247.683	−0.017
"	+0.49	247.711	+ 11
"	−0.90	247.695	− 5
"	+0.35	247.710	+ 10
30.95	−0.60	242.235	− 5
"	+0.90	242.230	− 10
"	+0.90	242.260	+ 20
"	−0.57	242.236	− 4

per cent $CuSO_4$, and that on the average the cell came to within 0.002 per cent of the equilibrium concentration of the salt.[6] Even with the maximum discrepancy (0.020 ohm) the uncertainty is only twice as large.

These results showed quite definitely that it was feasible to obtain complete equilibrium between salt and solution in the convection-cell, and they indicated that the cell could be used with confidence in determining the solubility of a salt under pressure, because, in whatever

[5] KOHLRAUSCH and HOLBORN. *op. cit.*, p. 151.

[6] It is interesting to note the relative effects of increased temperature and increased concentration on the resistance of a cell containing a saturated solution. At 30° an increase in temperature of 1° increases the solubility of $CuSO_4$ 0.25 per cent; the cell resistance would therefore decrease 0.25 x 5.5 or 1.4 ohm due to the solubility change. Since the temperature coefficient of the resistivity of a 19.6 per cent $CuSO_4$ solution at 30° is −0.019, the decrease in resistance due to temperature change alone is 0.019 x 240 or 4.6 ohms, which is over three times the change due to increased solubility. This illustrates the importance of maintaining the temperature constant to about 0.001°.

way the solubility were altered, by pressure as well as by changes in temperature, the cell would maintain saturated solution between the electrodes.

Experimental results with NaCl under pressure. As mentioned above, the first step was to determine the effect of pressure on the conductivity of sodium chloride solutions at constant composition. An extensive series of measurements at pressures up to 4000 bars, at various concentrations, and at a temperature of 30°, was made with the same cell as was used in the solubility experiments, except, of course, that no solid salt was placed in the cell. The method and results for the effect of pressure on conductivity will be published in detail elsewhere.

TABLE II.—RESULTS FOR THE EFFECT OF PRESSURE ON THE SOLUBILITY OF NaCl AT 29.93°

Pressure in bars	R_s, resist. of soln. satd. under pressure	R_p, resist. of 26.48 per cent soln. under pressure	$-\Delta R$ $(= R_p - R_s)$	$-\frac{\Delta R}{\Delta C}$	Increase of sol., per cent	Group Averages	
						P	ΔC
1	58.19_0	(58.18_8)	(-0.00_4)	0.41	0.00	1	0.00
293	58.40	58.49	0.09	.36	.26	300	.26
307	58.42	58.51	.09	.36	.26		
412	58.52	58.63	.11	.35	.32	412	.32
812	59.03	59.17	.14	.28	.51	845	.52
877	59.13	59.27	.14	.27	.53		
1258	59.76	59.90	.14	.21	.68		
1266	59.77	59.91	.14	.21	.68	1259	.66
1218	59.70	59.83	.13	.22	.60		
1293	59.82	59.96	.14	.21	.68		
1437	60.08	60.22	.14	.19	.75		
1429	60.07	60.21	.14	.19	.75	1428	.75
1419	60.05	60.19	.14	.19	.75		
1911	61.05	61.18	.13	.13	1.01	1911	1.01
1	58.18_7	—	—	—	—		
3649	65.77	65.58	−.19	—	—		
3637	65.75	65.55	−.20	—	—		

Next, the cell was filled with a saturated solution of NaCl, crystals of NaCl placed at the top and bottom, and the cell put in position in the bomb which was then supported in the thermostat at (or near) 30°. Pressure was then applied and held constant while readings of the cell resistance were made at suitable intervals of time until equilibrium was attained, as shown by resistance becoming constant, after which the pressure was increased and the same procedure followed. Usually, less than 24 hours was required for the attainment of equilibrium; the time required obviously depends on the preceding increment of pressure, which ordinarily was not large. The results are presented in Table II, the second column of which shows the equilibrium resistance,

R_s (in ohms), of the solution when saturated at the pressures indicated in Column 1. By interpolation from the results of the previous investigation on the conductivity of NaCl solution under pressure, the resistance, R_p, of a 26.48 per cent solution in the same cell at the various pressures was determined, as shown by the values in the third column. The difference, ΔR, is the change in resistance caused by the change in solubility of NaCl at the given pressure.

These changes of resistance were evaluated in terms of concentration by using the values of the resistance-concentration gradient at the various pressures, as calculated from the results of the preceding investigation. For this purpose the resistances at three concentrations were determined at even values of pressure by interpolation. These values are shown in Table III and Fig. 2. For each pressure the values of R and C (concentration in weight per cent) were fitted to an

TABLE III.—THE EFFECT OF PRESSURE ON THE RESISTANCE OF CONCENTRATED SOLUTIONS OF NaCl AT 29.93°

Pressure in bars	Resistance, R, of a cell with solution of concentration C (wt. per cent)			$\frac{dR}{dC}$ from eqn. (at $C = 26.48$)
	$C = 20.26$	$C = 23.92$	$C = 26.48$	
1	64.31	59.85	58.19	−0.41
1000	64.54	60.70	59.46	−0.25
2000	65.74	62.29	61.38	−0.11$_4$
3000	67.66	64.43	63.77	0.00
4000	70.16	67.08	66.60	0.1(?)

equation, and the resistance-concentration gradient, dR/dC, was then determined by differentiating the equation. This operation involved much greater difficulties than had been anticipated, principally because R as a function of C departs so much from linearity, especially at high pressures, that it is not easy to decide what type of equation to use. Measurements at a larger number of concentrations in the region near saturation should have been made, but this fact was not fully appreciated until after the apparatus had been dismantled. The last column of Table III shows the values of dR/dC (at saturation) obtained by fitting the results to the parabolic equation

$$R = a + bC + cC^2$$

in which a, b, and c are constants. It may be seen that the equation demands that R pass through a minimum and that at the higher pressures this minimum occurs at a concentration less than saturated. Hence, for pressures above 3000 bars, and in concentrated solutions, the resistance may actually increase with increasing concentration of

NaCl. This seemed rather surprising until it was noted that even at atmospheric pressure the resistivity of many salt solutions (e.g. $CaCl_2$) passes through a minimum at high concentrations.

Several other types of equation also were tried. The hyperbola, $R = aC + b + c/C$, gave results not very different from those obtained with the parabola, and, like it, gives a minimum in R at a finite concentration. But it seems probable that the simple parabola gives the

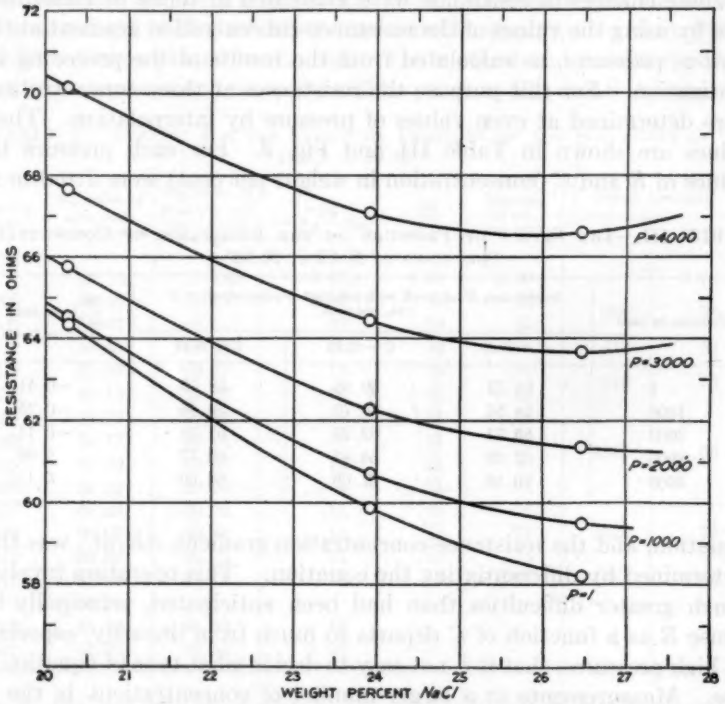

Fig. 2.—Resistance of the cell as a function of concentration at various pressures. At high pressures and in nearly saturated solutions the resistance *increases* with concentration.

best representation of the data, and, since it is somewhat more convenient to use, this type of equation was adopted. Two other three-constant equations, the hyperbola, $RC = a + bC + cR$, and the exponential, $R = a + be^{-cC}$, were tried and rejected when it was realized that this would require the values of R to be asymptotic to the C axis, and that this would be an arbitrary and unreasonable restraint.

The resistance-concentration gradients shown in the last column of Table III were plotted against pressure, and the values of this gradient

for the various pressures, as read from the graph, are given in the fifth column of Table II. With sufficient accuracy for the present purpose the gradient at a given pressure can be considered constant throughout the small range of concentrations encountered with NaCl solutions under pressure. Therefore, from the values of ΔR and $\Delta R/\Delta C$ the change of solubility is readily obtained by simple division.

The solubility of NaCl in water at 30.00° and *atmospheric pressure* was measured by shaking a mixture of solution and salt in a mechanical shaker operating within a thermostat, withdrawing a sample of the saturated solution and analyzing it by evaporation and careful drying. The average of 4 determinations, in which equilibrium was approached in both directions, was 26.470 per cent, the maximum deviation from the average being 0.007 and the average deviation being 0.004. Hence, the solubility will be taken as 26.47 per cent, and since the change for 1° temperature increase is only 0.01, 26.47 is the solubility also at 29.93°. The most concentrated solution used in the measurements on the pressure-coefficient of resistivity was, therefore, very slighty supersaturated (by 0.01 per cent). Moreover, its concentration, 26.48 per cent, was the reference point for the values of ΔR. Therefore, in order to determine the change of solubility from the values of ΔR in Table II, it is necessary to divide by $\Delta R/\Delta C$ and to add 0.01. The results of this operation are given in Column 6 and are the respective amounts by which the stated pressure has increased the solubility above the initial 26.47 per cent.

In the last two columns of Table II the values of P and ΔC for those pressures which are nearly the same have been averaged together to give a single pair of values for each group. These averages are plotted in Fig. 3, which shows graphically the effect of pressure on the solubility of NaCl in water at 30°. It may be observed that although a resistance measurement of the saturated solution was made at 3600 bars this result was not evaluated in terms of solubility-change. This was because of the uncertainty connected with the value of the resistance-concentration gradient $(\partial R/\partial C)_P$ for the nearly saturated solutions at the higher pressures. With increasing pressure the gradient decreases rapidly and changes sign at about 3000 bars. This unexpected circumstance makes it difficult to obtain an entirely satisfactory set of values of $(\partial R/\partial C)_P$ from the present data. Measurements of R should have been made at much smaller intervals at C close to the saturation-concentration, but the full importance of this was not appreciated until after the apparatus had been dismantled. It is interesting to note, however, that the value of ΔR, 0.20, at 3600 bars, as given

in Table II, is consistent with other measurements. The solubility change ΔC at 3600 bars is known to be 1.2 (see below). Hence $\Delta R/\Delta C$ is 0.1$_6$, which is not inconsistent with the values of this coefficient as determined directly from the conductivity measurements and as shown in the last column of Table III.

The system NaCl–H_2O turns out to be a peculiarly unfavorable system by which to try out the method here described for determining the change of solubility under pressure. This is on account of the

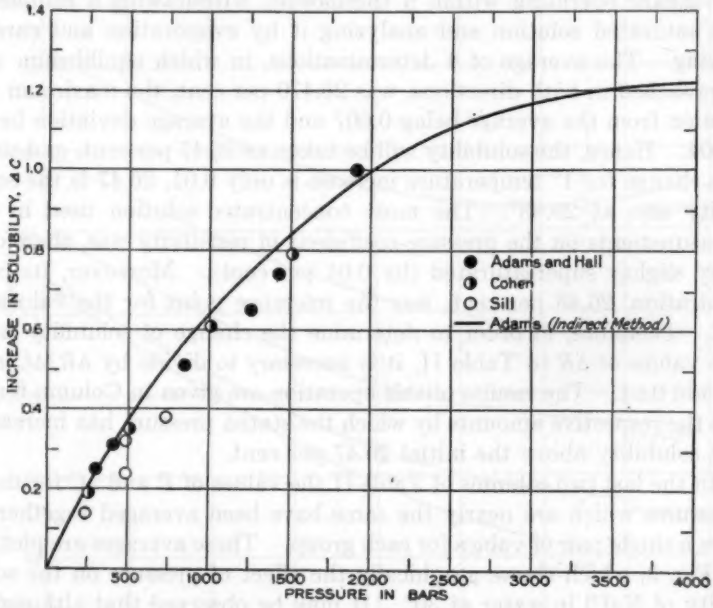

Fig. 3.—The change of solubility of NaCl with pressure. Some results of other investigators are included for comparison.

above-mentioned inversion in $(\partial R/\partial C)_P$ and also on account of the small change in solubility. Nevertheless, the results with this system are believed to be useful, and they quite justify the value and convenience of the method.

Comparison with previous determinations. In Fig. 3 there are also plotted the results obtained by Cohen *et al.*[7] and by Sill.[8] Cohen

[7] COHEN and SINNIGE. Zeit. phys. Chem. 67: 432. 1909; COHEN, INOUYE, and EUWEN. *Ibid.* 75: 257. 1911.

[8] SILL. Journ. Am. Chem. Soc. 38: 2632. 1916.

and his collaborators used an electromagnetic stirrer within the pressure bomb. After equilibrium beween solid and solution had been attained, the bomb was quickly opened and a sample of the solution withdrawn for analysis. Sill, on the other hand, had an arrangement for shaking the bomb, which was connected to the remainder of the pressure-apparatus by means of a piece of flexible copper tubing. A sample of the saturated solution was obtained by opening a valve while the contents of the bomb were still under pressure. The methods and results of other earlier investigators[9] on solubility under pressure are of little value for comparison here, because of an inadequate pressure-range, and insufficient precision in the measurements. The curve in Fig. 3 represents the unpublished determinations (by one of the present authors) of the change in solubility of NaCl under pressure at 25° by an indirect thermodynamic method. This indirect method involves the use of the compressibility and certain other properties of NaCl solutions and solid NaCl, and will be described fully in a forthcoming paper.

The various results shown in Fig. 3 are not strictly comparable, since the present results were obtained at 29.93°, those of Cohen *et al.* at 24.05°, and those of Sill at 25.0°. On the other hand, there are good reasons for believing that in this system a few degrees change in temperature will not have much effect on the *increase in solubility* caused by a given increment of pressure. Probably the correspondence of the three sets of results would not be altered noticeably by correcting them to the same temperature.

From the diagram it may be seen that on the whole the agreement between the various determinations is satisfactory. The average discrepancy of the results by the present method is probably not as much as 0.05 gram of NaCl per 100 grams of solution. Since the principal uncertainty is in the resistance-concentration gradient, more complete measurements on the electrical conductivity of nearly saturated solutions would make worth while the recording of one more digit due to change of solubility, and would therefore considerably increase the accuracy of the results. Furthermore, with a number of other electrolytes it should be possible to obtain easily an accuracy of better than 0.005 gram per 100 grams of solution.

Summary. A method has been developed for determining the effect of pressure on the solubility of salts and other substances without the

[9] e.g., FAVRE. Compt. rend. 51: 827, 1027. 1860; MOELLER. Ann. Phys. 117: 386. 1862; SORBY. Proc. Roy. Soc., 12: 538. 1863, Phil. Mag. 27: 145. 1864; BROWN. Ann. Phys. 30: 250. 1887. Zeit. phys. Chem. 1: 258. 1887; VON STACHELBERG. Zeit. phys. Chem. 20: 337. 1896.

use of a mechanical stirrer or shaking device. Essentially the method consists in measuring the electrical resistivity of the saturated solution in a special type of conductivity-cell in which a small amount of the solid is placed at the top and at the bottom and in which saturation takes place merely by convection.

Preliminary experiments at atmospheric pressure having shown that with solubility-changes induced by changes of temperature, equilibrium in the cell was attained within a reasonable time, measurements at pressures up to about 4000 bars (metric atmospheres) were made on the system, $NaCl$-H_2O, at 30°. The choice of this system turned out not to be a very happy one, because the resistance-concentration gradient (at constant pressure) in the saturated solution decreases rapidly with pressure and changes sign at 3000 bars; but although the data for the highest pressures could not be completely evaluated, the final results for the solubility-change agree satisfactorily with previous determinations by other means, and indicate that the present method is convenient and accurate.

BOTANY.—*The eastern short-stemmed leatherflowers.*[1] EDGAR T. WHERRY, University of Pennsylvania.

In current botanical manuals two species of short-stemmed broad-leaved leatherflowers are listed as present in the eastern United States, *Clematis ochroleuca* Aiton and *C. ovata* Pursh. Field studies of this group of plants in the Appalachian shale-barrens[2] and elsewhere have indicated that their relationships and ranges have been to some extent misinterpreted, as the data here recorded may serve to show.

The principal diagnostic features of the plants in question are presented in the accompanying key. Certain characters often regarded as significant have proved to be inconstant and variable, and have accordingly been omitted from consideration. For instance, leaf-terminations range from obtusish to acutish or even acuminate from one branch to another on a single plant. Again, the violet tinge on the outside of the sepals may be intense on one individual and almost lacking on another growing beside it, with intermediates elsewhere in the vicinity. Finally, dimensions of sepals and of achenes vary by 25% within any large clump, depending on the degree of maturity attained by the particular branch on which they are borne.

[1] Contribution from the Botanical Laboratory of the University of Pennsylvania. Received March 2, 1931.

[2] This JOURNAL 20: 46. 1930.

KEY TO THE EASTERN SHORT-STEMMED LEATHERFLOWERS (*Clematis* spp.)

Plant sparingly branched and small leaves relatively few; head of fruit tending to be spherical, about 6 cm. in diameter; achenes nearly symmetrical.
Under side of leaves glabrate to moderately pubescent; hairs of achene-appendages deep, or exceptionally pale, yellow; range chiefly at altitudes below 1000 feet, mostly in Piedmont....**C. ochroleuca ovata**
Under side of leaves moderately to densely pubescent; hairs of achene-appendages pale, or exceptionally deep, yellow; range chiefly at altitudes above 1000 feet, mostly in Blue Ridge....**C. ochroleuca sericea**
Plant copiously branched and small leaves relatively numerous; leaves glabrate.
Head of fruit nearly spherical, about 5 cm. in diameter; achenes fairly symmetrical, their appendage-hairs brown.....**C. viticaulis**
Head of fruit spheroidal, about 4 cm. high and 6 cm. broad; achenes rather unsymmetrical, their appendage-hairs whitish....**C. albicoma**

Clematis ochroleuca Aiton.—This plant varies in a number of respects from one clump to another, but the only features in which such variation shows any recognizable geographical relationships are those enumerated in the key. Two extreme variants with respect to degree of leaf-pubescence have received specific names, but in view of the complete gradation between them only varietal distinction seems justified. It is accordingly here proposed to divide this species into two varieties, as follows:

Clematis ochroleuca ovata (Pursh) Wherry, status novus[3]

C. ovata Pursh, not of current manuals
C. integrifolia α ochroleuca Kuntze.

The specimen on which Pursh based his specific name is preserved in the Sherard Herbarium at Oxford University, having been collected by Catesby and labelled by him with a citation from Plukenet, followed by the words "negroes head." The latter has been regarded as a locality,[4] but as Catesby did not in general add place-names to his labels, and as "nigger-head"—in allusion to the globular mass of kinky plumes—is the term universally applied to the leatherflowers by laymen in the south, it is believed to represent a common name instead.

In his work on the Natural History of Carolina, etc., Catesby did not mention this plant. Pursh[5] supposed it to have been obtained in South Carolina, Small[6] in that state or Georgia. It could equally well have come from Virginia, which was also visited by Catesby, as shown by the following quotation:[7]

"In the Year 1714 I travelled from the lower Part of St. *James's* River in *Virginia* to that Part of the *Apalatchian* Mountains where the Sources of that

[3] "*Status novus*" is believed to express the situation more accurately than the more frequently used "*combinatio nova*."

[4] Britton, Mem. Torr. Bot. Club 2: 28, footnote. 1890; Small, Flora Southeastern U. S. 439. 1903.

[5] Pursh, Flora Amer. Sept. 2: 736. 1814.

[6] Small, loc. cit.

[7] Catesby, Nat. Hist. Carolina, etc. 1: v. 1731.

River rise, . . . At the Distance of twelve Miles from the Mountains we left the River, and directed our Course to the nearest of them."

The specimen in question was examined by Asa Gray, who stated[8] that it "appears to be *C. ochroleuca*, Ait." It was later compared by Messrs. Vines and Druce with material from a West Virginia shale-barren sent to England for the purpose by Dr. N. L. Britton,[9] and was concluded by them to be identical with this. Their interpretation has been adopted in current manuals, but as there is no evidence that Catesby ever reached the shale-barren region, its reconsideration seemed desirable. Accordingly, at my suggestion, Dr. and Mrs. Francis W. Pennell kindly obtained data on the specimen in October 1930, and their description of it indicates clearly that it does not represent the shale-barren plant after all. In lacking small-leaved branches, and having relatively large leaves and a spherical head of achenes with pale yellow appendage hairs, it corresponds exactly to the plant of the Virginia and Carolina Piedmont.

The range of this variety is indicated by the following county records:[10]

GEORGIA.

DeKalb: Stone Mt., *Ashe*, not dated (N)

SOUTH CAROLINA.

Abbeville: Abbeville, *Porcher*, Aug. 1898 (U)

NORTH CAROLINA.

Alamance: Graham, *Biltmore*, May 26, 1902 (U)
Caldwell: Lenoir, *Biltmore*, May 17, 1902 (U)
Davie: Farmington, *Biltmore*, Aug. 27, 1895 (U)
Guilford: High Point, *Canby*, June 1868 (N)
Halifax: Weldon, *Williamson*, April 16, 1897 (N, P)
Iredell: Statesville, *Hyams*, June 1898 (N, U)
Polk: Lynn, *Peattie*, April 19, 1919
Randolph:———, *Ashe*, June 1895 (N)
Rowan: Salisbury, many collectors and dates (N, P, U).

VIRGINIA.

Arlington: many localities north of Alexandria (G, N, P, U)
Dinwiddie: Petersburg, *Tuomey*, not dated (P)
Fairfax: many localities south of Alexandria (G, N, P, U)
Fauquier: Buckland, *Meredith*, May 25, 1922 (P, U)
Greensville: Belfield (now Emporia), *Heller*, June 19, 1893 (G, N, P, U)
Henrico: Richmond, *Burk*, July 25, 1887 (P)[11]
Spotsylvania: Fredericksburg. *Ward*, May 3, 1872 (U).

[8] Gray, Curtis's Bot. Mag. [3] 37: pl. 6594. 1881.

[9] Britton, loc. cit.

[10] The following abbreviations are used for names of herbaria: G, Gray Herbarium; N, New York Botanical Garden; P, Academy of Natural Sciences of Philadelphia; U, U. S. National Herbarium.

[11] This specimen is especially similar in leaf outline and pubescence to the type of *C. ovata;* as Catesby would have started his 1714 trip in the vicinity of what is now Richmond, it is quite possible that they came from the same station.

PENNSYLVANIA.

Chester: London Grove (old record; no specimens seen).

NEW YORK.

Queens: Brooklyn, CAREY, May, 1841 (G, N)
Richmond: many localities on Staten Island (G, N, P, U).

Clematis ochroleuca sericea (Michaux) Wherry, status novus.

C. sericea Michaux.
C. ochroleuca β Torrey and Gray.
C. integrifolia α *ochroleuca* 2 *tomentosa* Kuntze.

Fig. 1. *Clematis albicoma* Wherry
West of Covington, Virginia, June 10, 1930.

This is the variety of *C. ochroleuca* which occurs at the higher elevations. It is characterized by its tendency toward tomentose pubescence on the leaves and pale hairs on the achene appendages. The most extreme material seen is that from Botetourt county, Virginia; the remaining records here cited are of specimens more or less transitional to the other variety.

GEORGIA.

Stevens: 5 miles west of Toccoa, *Wherry*, April 7, 1930 (P).

NORTH CAROLINA.

Forsyth: Salem, *Schweinitz*, not dated (P).

VIRGINIA.

Botetourt: Eagle Rock, *Lewis*, April 27, 1929 (P, Va. State Herbarium).
Roanoke: Roanoke, *E. G. Britton* and *Vail*, May 16–27, 1892 (G, N, P, U).

Clematis viticaulis Steele[12]

This species is known thus far only from the type locality, where it occurs on shale slopes along the railroad west of the tunnel. The characters listed in the key amply differentiate it.

VIRGINIA.

Bath: West of Millboro, *Steele*, Sept. 3, 1906 (N, U); *Wherry*, June 11, 1930 (P).

Clematis albicoma Wherry, nomen novum

C. ovata of current manuals, not Pursh

So far as recorded this plant was first collected on Kates Mountain by Gustav Guttenberg in 1877. The way it came to be identified with Pursh's *C. ovata* has been discussed above. It differs from that, however, in the respects enumerated in the key, and accordingly requires a new name, which is appropriately derived from its most unique character, the whitish hairs on the achene-appendages. It occurs on various shale-barrens, and has been collected from the following:

VIRGINIA.

Allegheny: 1½ miles west of Covington, *Wherry*, June 10, 1930 (N, P).
Bath: Hot Springs, *Hunnewell*, May 11 to July 3, 1911 (G)
Southwest of Hot Springs, *Wherry*, June 10, 1930 (P).

WEST VIRGINIA.

Greenbrier: Kates Mountain, many collectors and dates (G, N, P, U).

This is to be taken as the type locality of the species, and as type specimen should be designated:

Guttenberg, July 31, 1877 (U).

ZOOLOGY.—*A report on some amphibians and reptiles from New York and New Jersey.*[1] CHARLES E. BURT,[2] Trinity University. (Communicated by DORIS M. COCHRAN.)

During the academic year of 1929–1930, while I was a member of the herpetological staff of the American Museum of Natural History, I took the opportunity to make occasional studies of the local amphibians and reptiles, both in New York and New Jersey; and, as a consequence of this, the following locality data and ecological annotations have been gathered.

With future continuation of the phenomenal constructive activity at present in progress in the New York City region, it is evident that

[12] Steele, Contr. U. S. Nat. Herb. 13: 364. 1911.

[1] Received March 13, 1931.

[2] Professor of Biology, Trinity University, Waxahachie, Texas.

great ecological pressure will be brought to bear on the local fauna and that progressive extermination or succession of animal communities at many points must inevitably follow. In view of this, concise locality data on the local fauna, as opposed to generalized records, are especially needed. Noble (1927) in his "Distributional List of the Reptiles and Amphibians of the New York City Region," which presents only a preliminary statement of the general range of each of the local species, called attention to this need by writing that "Exact locality records of practically all our species are greatly desired. It is only when they are brought together that a clear picture of the distribution of our local species can be obtained."

SALAMANDERS

Triturus viridescens viridescens (Rafinesque).—On April 12 a small red eft, the land form of the common newt, was obtained 4 miles north of Alpine, Bergen County, New Jersey, among soggy, dead leaves near a semi-stagnant streamlet, which was found to contain developing egg masses of the wood frog, *Rana sylvatica*. On April 19 another example was secured near this point in the water of a stagnant, leaf-filled roadside ditch; and on this same date two others were taken 3 miles north of Engelwood, Bergen County, New Jersey, in a swampy area where they were sheltered by crevices in the rocks.

Plethodon cinereus (Green).—This salamander was commonly found in woods under stones and in or under rotting logs or other objects when sufficient moisture was available. It appears that in the spring there is often too much moisture for *cinereus* in the valleys, but too little on the more exposed hilltops. At this time the maximum abundance is found on the hillsides where moisture and protection are more nearly at the optimum. Later, if the summer brings drying, a migration into the valleys or a disappearance into subterranean retreats probably takes place.

In New Jersey, both dark and red-backed phases were common. On April 7 and April 12 small series were secured 4 miles north of Alpine, Bergen County, from under stones and from rotted wood on a timbered hillside above a small stream, but on April 19 a total of 114 specimens was secured here within a period of about two hours. On the latter date *cinereus* was found to occur 3 miles north of Engelwood, Bergen County. On October 12–13 specimens were collected 1 mile north of Island Heights and at Lakehurst, in Ocean County. At the last locality individuals were found in damp situations under pieces of tin, cardboard and cloth, as well as under damp bark and leaves.

In New York, a small individual secured at West Haverstraw, Rockland County, on April 12, was found to have a perfectly developed red-backed color pattern. It measured 15 mm. from snout to anus, and the tail was 10.5 mm. long (total length, 25.5 mm.). In the laboratory this small creature showed a tendency to get a running start before making the characteristic jump of the species, demonstrating this method several times. The jumps

were only about an inch in length. Additional New York representatives of this salamander were obtained 1 mile south of Harriman, Orange County; 12 miles southwest of the St. George Ferry, Staten Island, Richmond County; 2 miles north of Rockland Lake, Rockland County; and at Grassy Sprain Reservoir, Westchester County. The last place was visited on June 11 and specimens were found to be scarce because of a drying of the woods.

Plethodon glutinosus (Green).—Several specimens of this form were removed from under flat rocks on a wooded hillside 4 miles north of Alpine, Bergen County, New Jersey, on April 12 and April 19. In this vicinity *glutinosus* apparently occupies the same general situations as the much more abundant *cinereus*.

Pseudotriton ruber ruber (Sonnini).—On April 7 the red salamander was found 4 miles north of Alpine, Bergen County, New Jersey; and on April 19 it was taken 3 miles south of Piermont, in the same county. At both places the species was dislodged from under flat rocks near the edge of shallow, clear, cold bodies of running water, and in each instance individuals attempted to escape by diving downward toward crevices among the rocks at the bed of the stream.

Eurycea bislineata bislineata (Green).—On April 7 two-lined salamanders were discovered under rocks at the border of a small stream 4 miles north of Alpine, Bergen County, New Jersey, and on April 19 others were found in a similar situation 3 miles south of Piermont (Bergen County, New Jersey). These attempted to escape by lodging under rocks in the water below. On April 12, examples were secured among soaked leaves in the pathway of seepage from a spring near a small stream 1 mile south of Harriman, Orange County, New York, and on April 16 specimens were taken in a similar habitat at Grassy Sprain Reservoir, Westchester County, New York.

Desmognathus fuscus fuscus (Rafinesque).—The dusky salamander was found in very moist situations under rocks or leaves near streams or pools and, upon being disturbed, it usually tried to escape by rushing toward the water. In Bergen County, New Jersey, the species was procured on April 7 near a streamlet 4 miles north of Alpine, and on April 19, near a larger flow of water 3 miles south of Piermont. The New York specimens of *fuscus* were all collected on April 12. They were found 1 mile north of Lake Tiorati, near the "Seven Lakes Drive," and 1 mile south of Harriman, both localities being in Orange County; and under rocks near a small stream on the north slope of Dunderburg Mountain, in Rockland County.

TOADS

Bufo americanus Holbrook.—On April 19 this toad was taken 1 mile north of Leonia, Bergen County, New Jersey. On this cold evening many individuals were calling from an extensive fresh-water swamp in the vicinity, but only a few clasping pairs were located. The female of one such pair was laying eggs and females transferred to the laboratory deposited eggs during the night.

An examination of a series of these toads revealed some with distinct black

spots below and others without such markings; but most of them had at least a few faint black spots or slaty patches on the upper chest.

Bufo fowleri Garman.—*Bufo fowleri* GARMAN, Bull. Essex Inst., **16**: 42. 1884 (type locality, Massachusetts).—*Bufo terrestris* BURT and BURT (not of Bonnaterre), Amer. Mus. Novitates, no. 381, 1929, p. 2 (reports from Louisiana, Texas, and Arkansas).—Through the courtesy of Mr. J. T. Nichols I had the opportunity to hear the call of *Bufo fowleri* at Garden City, Nassau County, New York, in June 1930. I recognized it at once as the same "goat-like" cry that I had heard in the Mississippi Valley the year before. The latter toads were doubtfully reported by Burt and Burt (1929) as *Bufo terrestris* on structural characters alone, but I am now convinced that they are *B. fowleri*—vocally at least! To this latter category the report of *B. woodhousii* Burt and Burt (1929) from 6 miles south of Vinton, Calcasieu County, Louisiana, which are based on young specimens, should probably also be placed.

Frogs

Acris gryllus (Le Conte).—A cricket-frog was captured on October 13 at the edge of a shallow pond, 12 miles southwest of the St. George Ferry, Staten Island, Richmond County, New York.

Hyla crucifera Wied.—*Hyla crucifer* WIED, Reise Nord-Amer., 1^{2}: 275. 1838 (type locality, Catonment Leavenworth, "Kansas").—*Hyla crucifera* MYERS, Proc. Indiana Acad. Sci. for 1926, **36**: 338. 1927.—Spring-peepers were singing in Bergen County, New Jersey, on April 7, 19, and 28. They were abundant 1 mile north of Leonia, 1 mile north of Oradell, and at Harrington, particularly in flooded meadows where they clung to grass stems. Several specimens from the last locality had broken or incomplete crosses on their backs. In New York, *crucifera* was secured at the edge of a shallow pond 12 miles southwest of the St. George Ferry, Staten Island, Richmond County.

Hyla triseriata Wied.—*Hyla triseriata* WIED, Reise Nord-Amer., 1^{1}: 249. 1838 (type locality, Mt. Vernon, Ohio River, Indiana).—*Pseudacris triseriata* STEJNEGER and BARBOUR, Check List N. Amer. Amph. Reptil., ed. 2, 1923, p. 29.—In an area of flooded grass-land 1 mile north of Oradell, Bergen County, New Jersey, it was found that frogs of this species were much more wary and harder to secure than those of *Hyla crucifera* (April 19).

Rana catesbeiana Shaw.—On April 28 a bullfrog was found sitting in the water of a pond 1 mile north of Leonia, Bergen County, New Jersey, but the song of the species was not heard at this time.

Rana clamitans Latreille.—Green-frogs are common in the vicinity of the larger of the small streams at the localities given below, as well as about small lakes and ponds. On April 20 they were very hard to secure at Garfield, Bergen County, New Jersey, where they often escaped by diving. Specimens were taken in the daytime from under flat stones near streams at Queensboro Lake and 1 mile north of Lake Tiorati, in Orange County, New York, on

April 12, and on October 13 several examples, including a tadpole, were collected 12 miles southwest of the St. George Ferry, on Staten Island, Richmond County, New York.

Rana halecina Linnaeus.—*Rana halecina* LINNAEUS, Syst. Nat., ed. 12, pt. 1, 1766, p. 356 (first latinized binomial name for Kalm's *sillhoppetosser*, type locality, New Jersey).—BOULENGER, Proc. Amer. Acad. Arts and Sciences, **55**: 433. 1920.—BURT, Proc. Biol. Soc. Wash., **44**: 13. 1931.—*Rana pipiens* SCHREBER, Der Naturforscher, **18**: 182, pl. 4. 1782 (type locality, Pennsylvania).—Leopard frogs were calling in Bergen County, New Jersey, on April 19, where they were secured at Garfield and 1 mile north of Leonia.

Rana sylvatica Le Conte. On April 7 woodfrogs were not in full song at Harrington, Bergen County, New Jersey, but their notes were occasionally heard. Large egg masses were seen in a flooded meadow in this vicinity, and this indicated that the height of the mating season had passed. Examination of clusters revealed living embryos in various stages of development.

On June 11 adult woodfrogs were obtained in Donald Park, Westchester County, New York, where they sought concealment by hopping into masses of green vegetation. A pond near here sheltered *Rana clamitans*, as attested by the characteristic "zoom" which came from that quarter.

Lizards

Sceloporus undulatus undulatus (Latreille).—On the sunny afternoon of October 12 pine lizards were very abundant about logs 1 mile west of Lakehurst, Ocean County, New Jersey.

Leiolopisma laterale (Say).—One of these little skinks was taken near a pile of brush 1 mile west of Lakehurst, Ocean County, New Jersey, in the same general habitat as *Sceloporus undulatus undulatus*.

Snakes

Lampropeltis triangulum triangulum (Lacépède).—On June 11, 1930, a young specimen of this king-snake, probably of the 1929 brood, was found in the open road in Donald Park, Westchester County, New York, where a stone pile at the side of the highway probably served as its home.

Natrix sipedon sipedon (Linnaeus).—This water snake was captured near a stream in the vicinity of the railroad station at Tappan, Rockland County, New York, on April 15.

Thamnophis sirtalis sirtalis (Linnaeus).—On the sunny afternoon of October 13, one of these snakes wandered into the road from its abode at the margin of a salt marsh 1 mile west of Matawan, Monmouth County, New Jersey; and here it was easily captured.

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ETHNOLOGY.—*The Caddo social organization and its possible historical significance.*[1] JOHN R. SWANTON, Bureau of American Ethnology.

A large number of Indian tribes, as is well known, were divided internally into social groups called *clans*, *gentes*, or *sibs*. These usually, though not invariably, bore the name of some animal, plant, or natural feature, and where this was not the case they often maintained special relations with such organisms or objects. Associations of this kind constitute what we know as totemism and have been the occasion of endless discussion.

A striking characteristic of these tribal subdivisions is the fact that they were usually perpetuated either in the male line or the female line exclusively, and the terms above mentioned have been given technical definitions accordingly, a *clan* referring to a social group perpetuated in the female line, a *gens* to one perpetuated in the male line, while *sib* is employed when one wishes to indicate either indifferently. Often the sibs in any given tribe form larger groupings for which the terms *phratry* and *moiety* are used, the latter mainly restricted to the very common condition where there are but two major classes such as are represented among the Iroquois, Choctaw, and Haida.

Divergencies from the standard are numerous, and it is always interesting to discover one of these since atypical forms usually throw more light upon the origin of the institution than those which fall into the classic categories.

When the writer was among the Caddo Indians near Anadarko, Oklahoma, about twenty years ago, he elicited some interesting information of this sort, but it has lain in manuscript because he was not then able to follow up the matter or check it. While he has not been able to verify this since, it seems worth while to make it a matter of record as there is no reason to doubt its substantial accuracy, and it suggests some important conclusions.

The living Caddo consist of remnants of two considerable con-

[1] Received March 25, 1931.

federations of five or six tribes each and two or three unattached tribes, which together occupied a large territory in parts of Louisiana, Texas, and Arkansas, where the three states meet. The speech of the two main groups differed only in a few words and some easily recognized sound shifts. The tongue, or tongues, of the isolated tribes were, on the other hand, widely divergent, but they have been long extinct and do not here concern us.

Some years before the writer's visit, Mr. James Mooney, also of the Bureau of American Ethnology, spent a short time with the Caddo and he obtained a few notes regarding their clan divisions—for descent was usually reckoned by them in the female line—which were incorporated into the article on the Kadohadacho or Caddo proper, in the Handbook of American Indians. He learned the names of ten clans, as follows: Sun, Thunder, Eagle, Panther, Raccoon, Beaver, Crow, Bear, Wolf, and Bison. Caddo Jake, the oldest Indian of the tribe living in 1912 when the writer visited them, stated that this list was correct so far as it went, but he thought it was not sufficiently extensive. At an earlier period he believed there had been still other clans.

However, particular interest attaches to information obtained from a second Caddo named White Bead whose age was almost equal to that of the man just mentioned. According to him there were but five clans, arranged in something of a caste system, with the animal esteemed most powerful at one end and the weakest at the other. In order of "strength" these clans were: Bison, Bear, Panther, Wolf, Beaver. Another irregularity was the fact that a man could marry a woman of his own clan, and vice versa, but this was evidently necessary if the facts regarding clan intermarriage were as reported. Thus, it was said that in case of marriage between a woman of a "stronger" clan and a man of a "weaker one," all of the children belonged to the former, while in case of marriage between a man of a strong clan and a woman of a weak one, the boys were allocated with their father's people and the girls with their mother's. If marriages between clans had been frequent, it is evident that the stronger ones would have gained constantly on the weaker ones to the probable extinction of some of the latter.

White Bead added that, when inter-clan marriages of this kind took place, the near relatives on each side could make fun of, and play pranks upon, each other. Nothing was thought of it if persons connected in this way used the most outrageous expressions. If a man saw another bearing this relation to him mounted on a good horse, he

could order him to dismount and ride away on it himself, leaving his victim to get even at some future time as best he could.

Anciently each clan had its particular story, and all of these were supposed to fit together so as to make one narrative.

The disagreement between White Bead's information and that of Caddo Jake is not as important as might at first appear because White Bead belonged to one of the tribes of the western Caddo, the old Hasinai confederation, while Caddo Jake came from the Natchitoches tribe, from the easternmost part of the former Caddo country. These were separated sufficiently to have had quite diverse social systems.

It is also to be remembered that the Natchitoches, who seem to have preserved the stricter clan system, were not far removed from tribes similarly organized, such as the Creeks and Chickasaw. In historic

TABLE I

	Caddo	*Creek*	*Chickasaw*
Bison	*tanaha* (N)[2] *tāna'* (H)	*yanasa*	*yannash*
Bear	*namtsi* (N) *nawotsi* (H)	*nokosi*	*nita*
Panther	*kĭshĭ'*	*katca*	*koi*
Wolf	*tāsha*	*yaha*	*nashoba*
Beaver	*tc!aōk* (N) *t!aox* (H)	*itcha'swa*	*kinta*
Eagle	*ĭmĭ* (N) *ĭwĭ* (H)	*lamhi*	*oñssi*
Raccoon	*ōt*	*wotko*	*shaui*

times the latter were less remote geographically but there is reason to think that they had borrowed their own organization from the Creeks. Under such circumstances it is particularly interesting to find certain striking resemblances between the Creek and Caddo names for those animals which both employed as designations of clans. To appreciate the force of this comparison the two are placed side by side in the subjoined table along with the Chickasaw, and it is to be remembered that, when all three tribes were first known to Europeans, the Caddo and Creeks were entirely separated from each other by the Chickasaw and Choctaw (the Choctaw language being almost identical with Chickasaw). Where the Natchitoches and Hasinai languages employed different terms for the animals in question, both have been inserted and distinguished by the letters N and H.

The first of the above comparisons may be left out of consideration because one word for "bison," with slight variations, is used throughout

[2] In these words, accents and most diacritical marks have been omitted, *tc* is employed for English *ch*, *x* for German *ch*; *ñ* indicates that the preceding vowel is nasalized, and *!* that the preceding consonant has an explosive sound.

the Gulf area in languages wholly unrelated. Of the remaining six there is only one, the term for "wolf," in which the Chickasaw form seems to be somewhat nearer that employed in Caddo. The remaining terms speak for themselves. Further indication of a former more westerly location of the Creeks is furnished by the Tunica language, spoken by a small tribe between the Chickasaw and Caddo, in which the word for "bear" is identical with that of the Creeks, and still another is supplied by the Creek migration legend which refers their origin to some point west of the Mississippi. The Caddo migration legend strengthens this by assigning Caddo origins to the region about Hot Springs, Arkansas, or the territory immediately southwest of it. What we know of the ceremonial mound system of the Creeks seems also to fall in line with the theory since it was of a type found along the lower Mississippi.

But if the clan system, as exemplified particularly by the eastern Caddo, suggests Creek contact, the caste features of the Hasinai recall the old Natchez system and may indicate that the western Caddo were once on Red River south of their kindred.

CONCLUSIONS

There are indications that the clan systems of the eastern and western Caddo differed, and that they grew up in contact with the clan system of the Creeks, probably in the territory now embraced in the State of Arkansas, but certain features of the western Caddo system suggest contact with tribes of the Natchez group, probably in what is now Louisiana. This last point is left in considerable doubt by lack of confirmation of the writer's data regarding western Caddo social organization, but that does not affect the rest of the argument. It may be found to have a bearing on the origin of the higher forms of culture on the lower Mississippi associated with the peoples loosely called "Mound Builders."

SCIENTIFIC NOTES AND NEWS

Resignation of JOHN E. GRAF as assistant chief of the Bureau of Entomology of the Department of Agriculture, to become associate director of the National Museum was announced recently. S. A. ROHWER, assistant chief of the plant quarantine and control administration, was appointed to fill the vacancy caused by the resignation of Mr. GRAF.

The Hillebrand prize of the Chemical Society of Washington has been awarded to Dr. CLAUDE S. HUDSON, professor of chemistry at the National Institute of Health of the Public Health Service, for his work on the ring structure of sugars.